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Issue Paper I

THE NECESSITY OF AN INTEGRATED APPROACH TO FERTILIZER PRODUCTION AND USE IN AFRICA*

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1. Introduction and summary

The complexity of African agriculture is being increasingly subjected to expert scrutiny.

Concerned governments and the international community have demonstrated a profound anxiety regarding, and a painful awareness of, the plight confronting millions of persons. As a result, there is no scarcity of general prescriptions and policy guidelines designed to alleviate the crisis of famine.

The Food and Agriculture Organization of the United Nations has recently published the findings of a major study on African agriculture and its prospects for the next 25 years. 1/ The report is centered on an in-depth investigation of the underlying causes of the decline, which, contrary to conventional wisdom, has been in the making for at least two decades. The study also assesses in detail Africa's potential for recovery and analyses the ways to mobilize the necessary resources.

The many factors contributing to the difficulty of securing growth in African agriculture are not always fully understood in their manifold interactions. Obviously these factors cover a wide range, from government policies and resource endowment to the adequacy of input supplies and the efficiency of the economic environment in which farmers and traders have to operate.

For these reasons, it would be pretentious and misleading to prescribe simplistic remedies or even to predict structural changes as a result of implementing such recommendations.

Nevertheless, even a cursory knowledge of the peculiarities of African agriculture should rule out any attempt to transfer the impressive experience of Asia's so-called "green revolution" in view of the fundamental differences in the ecology and culture of the continent. Moreover, Africa cannot be treated as a whole, so that country or regional analysis is inevitable.

It is, however, widely recognized that among all the external inputs to agriculture designed to increase crop productivity, chemical fertilizers figure most prominently. Therefore, the role of plant nutrients (nitrogen, phosphates and potash) is indispensable in any strategy to boost agricultural output. Increased fertilizer use has undoubtedly been one of the main reasons behind the growth of some developing countries' agriculture in recent years.

The intention of this paper is not to duplicate similar efforts in the past by launching yet another investigation into the root causes of the stagnation in African agriculture, but rather to recapitulate systematically and focus on those factors that, taken together, have inhibited a wider and more efficient use of fertilizers in Africa. At the conclusion, suggestions are made for removing these obstacles through what must necessarily be an integrated approach consisting of complementary measures to promote the use of these chemicals on the continent. It should be recalled that Africa's insufficiency in food production, however alarming its current proportions, is still perfectly capable of a rapid and catastrophic further deterioration if current trends are not arrested and ultimately reversed.

1/ African Agriculture: The Next 25 Years (Food and Agriculture Organization of the United Nations).

2. Current obstacles to the use of fertilizers

2.1 Agricultural pricing policies and subsidies

Price support practices for crops and fertilizers

The prices of agricultural products are often not high enough to encourage farmers to use fertilizers, which are frequently very expensive. Among the most striking examples of non-remunerative price relationships in Africa, the cases of Ethiopia and Zambia might be mentioned. In these two countries, farmers selling their grain harvests to official agencies in the early 1980s were being paid about one half of the 1970s price in constant terms.

These policies mainly affect products intended for export, but also affect those destined for the internal market. The result of this is that the urban population often benefits from artificially low price levels to the detriment of farmers. As a consequence, rural exodus to the cities is accelerated, permanently depriving the agricultural sector of part of its work-force.

Often, local production also suffers from subsidies for imported agricultural commodities, making it less competitive. On the other hand, subsidies that are granted by governments for imported fertilizers do not always encourage consumption in the intended way and may discourage local fertilizer production.

In this way, pricing and subsidy policies often inhibit both the use and production of fertilizers.

Loans, incentives and credits

Few farmers have sufficient savings to enable them to purchase fertilizers several months before they are paid for their harvests; in addition, they frequently experience difficulties in obtaining credits.

Because the relevant financial institutions are under-resourced and often inefficiently managed, loan applications are refused to farmers who own small holdings, to women who manage their farms on their own and to share-croppers. Some farmers have no access to credit facilities simply because they are located too far away from the financial institutions.

Finally, in most African States, there are no preferential loans or subsidy policies destined for agriculturalists.

The farmers' terms of trade

Since the beginning of the 1980s, the terms of trade for African exporters of agricultural commodities have been detrimentally affected by the decline in prices and the stagnation in volume of sales. At the same time, the prices of imported products have continued to increase.

This deterioration of the terms of external agricultural trade (about 10 per cent in 1985 and certainly more in 1986, according to FAO) contributed to worsening the liquidity of farmers, all the more as governments did not provide sufficient support; the situation is especially difficult for

small-scale farmers and in particular for the share-croppers who pay for all of their inputs, including fertilizers, while being compensated for only part of what they produce.

2.2 Physical and environmental conditions

Nutrient depletion and soil erosion

One of the major problems of the African agriculture is permanent soil deterioration (erosion and depletion of nutrient content), attributable to many factors, among them reduced arable acreage as a result of population growth, overworking of the available land and insufficient soil management. Losses are sizeable and contribute to reducing income available for purchasing fertilizers. For example, each year Zimbabwe loses 15.6 million tonnes of organic matter, 1.6 million tonnes of nitrogen and 240,000 tonnes of phosphorus due to top soil erosion. The use of fertilizer in sufficient quantities to replace these losses would cost some $1,500 million per year. The estimated cost of the erosion is put at $20-$50 per cultivated hectare. Insufficient fertilizer use favours soil depletion, bringing about a reduction in yields and consequently in fertilizer purchases, and finally further soil deterioration.

Irrigation and water management

Inadequate water resources and irrigation systems also constitute a major obstacle to African agriculture and to fertilizer use, as fertilizers are inefficient if not used with adequate irrigation. Africa has vast deserts (30 per cent of the total surface), tropical regions (overabundant rainfall) and very often irregular rainfall. Added to these are financial constraints, insufficient skilled personnel and other constraints to the improvement of irrigation systems. These conditions only increase the farmer's desire to reduce risks to all kinds of capital exposure, and specifically to fertilizer purchases.

Pre- and post-harvest losses

Farmer income is also diminished because of large production losses occurring before and after harvest. Pre-harvest losses may amount to as much as 30 per cent of production. The plants suffer from drought and insect attack. The irrigation systems and use of pesticides are often insufficient to limit this damage.

Following harvest, the crops are further diminished as a result of poor handling, processing and inappropriate storage. There is a lack of processing facilities, silos and know-how. In some countries (the Sahel) these losses may amount to as much as 40 per cent of production.

2.3 Effectiveness of fertilizer application

Paucity of agronomic data for proper fertilizer use

In Africa, agronomic testing to detect soil deficiencies and determine crop requirements for fertilizers under varying soil management and climatic conditions remains rudimentary, thus diminishing the potential benefit of

fertilizer use, which has to be convincingly demonstrated to the farmer through trials on his field. Moreover, research is more oriented to drought- and disease-resistance than to fertilizer responsiveness. African soils vary greatly in their physico-chemical properties, composition and reaction to external nutrition. It would therefore be difficult to formulate an integrated plant nutrition approach. Further difficulties come from:

(a) Inadequate field of experimentation based on agronomic data;

(b) Lack of appropriate application technologies;

(c) Failure to observe requirements of integrated plant nutrition;

(d) Absence of the required balance between plant nutrients in fertilizer products;

(e) Non-optimal application rates and schedules;

(f) Lack of adequate irrigation and related facilities.

Unavailability of required fertilizer types

In order to be effective, the fertilizers used must be the right kind for the plants and soils in question and must be applied according to the prescribed schedules. This implies a knowledge of the nature, frequency and quantity of fertilizer requirements and scrupulous adherence to them. However, as already pointed out, the data to permit identifying these requirements and the infrastructure to allow satisfying them, are inadequate.

By way of example, mention might be made of the phosphate fertilizers sold to Mali and to Burkina Faso. These locally produced fertilizers were presented in a powdery form, which was not popular with the farmers because of the associated dust, and they soon stopped using them.

In Niger, a fertilizer produced from the output of the Tahoua phosphate deposits was marketed, but it was found to be totally ineffective for local soils and crops. Despite subsidies, the farmers either refused it outright or else used it to give a pebble-dash finish to the walls of their houses.

Shortcomings of agricultural extension services

The role of the extension services is, in principle, to assist farmers in modernizing their farms. They do this by acting as an intermediary in the transmission of information between the agricultural sector and other sectors of the economy, specifically industry and the research community. Accordingly, these services should contribute to the more extensive use of fertilizers by informing farmers about the varieties to be used and the methods of application and by helping them to obtain the necessary resources to this end.

In point of fact, the extension services rarely perform this basic mission, for two main reasons:

(a) In the first place, the services lack resources: the personnel, who are too few, have not received the proper training and are poorly paid. Moreover, the agents do not have available the necessary equipment (they lack, for example, vehicles to enable them to maintain contact with all the farmers they are supposed to be serving);

(b) In the second place, the role of these services is poorly defined. The initial objective described above usually runs into a major difficulty - the lack of development in the other sectors mentioned. As a result, extension services have gradually been transformed into sales promotion agencies, particularly for agricultural exports.

The consequence is that the extension services are hardly participating in the effort to encourage the use of fertilizers. Instead, they frequently concentrate their efforts on a small number of farmers, namely the wealthiest and the best educated. Thus, extension workers are largely unfamiliar with farmers' grass roots problems and are not in a position to interact with the research community.

2.4 Technological and socio-cultural factors

Agricultural techniques

The use of machinery is an essential element in developing the use of fertilizers, which require additional work. Without machines to help, the farmer would regard this work as excessive in comparison with the benefits he expects to derive from it.

As it happens, the growth rate in agricultural mechanization in Africa is the lowest in the world. Between 1980 and 1983, Africa recorded the lowest rate of increase in the number of tractors; the figure was five times lower than that for Latin America and ten times lower than that for the Far East.

Apart from the large plantations whose output is intended for export (cacao, cotton etc.), little use is made of machines, and farmers continue to adhere to very traditional cultivation methods. Many operations are performed by hand. In some areas, not even animal traction is used. The purchase of machinery entails a sizeable investment beyond the means of most farmers.

The problem is compounded by the lack of appropriate application technologies that take into account the specific socio-cultural requirements of the African farmer. The conventional methods of fertilizer use have been developed and refined for an entirely different communications system. The transfer and absorption of technology for fertilizer application constitutes a major stumbling-block to the increased use of fertilizers in most rural communities on the continent and poses a serious challenge to the agricultural extension services.

Lack of skilled manpower

A skilled manpower shortage affects most sectors of African economies and specifically agriculture. This is due to the lesser development of local training facilities and insufficient support from the governments as compared to other sectors. The number of persons trained is very small in relation to the importance of agricultural development in Africa. According to a 1983 IBRD survey, 1 per cent of African students were pursuing training in the field of agriculture and only 0.14 per cent of the population employed in the agricultural sector had received any training at all.

Another point to be emphasized is that the few training programmes that do exist are not geared to meet the real requirements. There is a lack of

personnel trained locally and capable of dealing effectively with all stages of the agricultural process - input procurement, production, marketing and distribution.

The traditional monoculture system

One of the charateristics of African agriculture is the large-scale monoculture system inherited from the colonial period. This system provides large volumes of export products: tea in Kenya, cacao in Côte d'Ivoire, tobacco in Malawi, cotton in the Sudan etc. The sale of these products is frequently the principal source of income for African countries. Under a short-term strategy aimed at ensuring foreign exchange revenue, efforts are principally focused on improving monoculture yields. However, over the longer term, a systems approach involving all the technical and socio-economic aspects of agriculture could be more appropriate.

Orientation to monoculture farming neglects such important elements as:

(a) Deterioration of the soils caused by the monoculture system;

(b) Continued export dependence both at the level of the individual farmer and at the national level;

(c) Adaptation of production to local demand.

All of these elements would justify priority being given to research into the possibilities of crop diversification as a function of production constraints and consumption requirements.

Foreign exchange and external trade

Since the beginning of the 1980s, African countries have suffered from an increasing shortage of foreign exchange with which to finance their fertilizer imports. This is due to the concurrence of a number of factors that have curtailed their foreign exchange revenues from their commodity exports. Essentially, there are four such factors:

(a) The decline in prices and in the trading volumes of raw materials, which are the principal export items of African countries;

(b) Protectionist measures introduced by the developed countries;

(c) Competition of other developing countries. The Asian countries, in particular, have gained control of market segments that previously belonged to the African countries;

(d) Wide fluctuation in foreign exchange parities.

As a consequence, Africa's imports of fertilizers stagnated between 1982 and 1986 at a level slightly above 1 million tonnes per year. By way of comparison, it is worthwhile noting that during the same period, imports of fertilizers by the developing countries of the Far East nearly doubled, increasing from 3.8 million tonnes in 1982/83 to 6.4 million tonnes in 1984/85, despite a sizeable increase of their domestic production.

Transportation and marketing

Fertilizers are heavy and bulky products that must be delivered to the farm in large quantities and on pre-agreed dates. Their use depends to a significant degree on the transport and distribution infrastructure, which in Africa is usually inadequate.

The transport networks are not extensive enough. Many regions are isolated, especially in land-locked countries. Overland communication routes usually converge on the ports, and there is an acute lack of regional and interregional transport arteries. The existing communication routes are rudimentary. In the countryside, these are most often simple trails, unsurfaced and unmaintained.

In recent years, transport problems have grown worse. The governments lack the foreign exchange with which to import machinery and spare parts and they lack the know-how required for the construction of new roads and the maintenance of the existing networks. As a consequence, regions with no access to efficient, all-year-round transport systems are unable to obtain fertilizers.

2.5 Insufficient domestic production and related supply constraints

Domestic production of fertilizers

There are many possibilities in Africa for the production of fertilizer, particularly from phosphates. In fact in 1985, Africa furnished 44 million tonnes of natural phosphates, or 32 per cent of world production, with north western Africa alone accounting for 20 per cent of world production. The main deposits in operation are located in Morocco, Tunisia and Algeria, but there are also some in Togo, Senegal, Egypt, Uganda, Angola, Zimbabwe and South Africa. Many other countries have workable sites. However, these assets are substantially underworked for the production of fertilizer.

There are a number of problems inhibiting the development of fertilizer production on the continent. Fertilizer production plants are capital-intensive because they require sophisticated technology. The costs are particularly high in Africa owing to the scarcity of a number of production factors. Often the shortage of trained local manpower makes it necessary to hire foreign experts. Similarly, most of the equipment and machinery has to be imported. The inadequacies of the infrastructural systems impose additional costs. The investments are all the more burdensome in that the essential items must, as a general rule, be paid for in foreign exchange.

Cost of fertilizer production

The phosphate fertilizer production units in Africa are operating at substantially less than full capacity. During 1985-1986, phosphate fertilizer production was only 34 per cent, on average, of the installed capacity for the entire continent. Utilization rates range from 70-80 per cent (Senegal, Zimbabwe and Egypt) to only 8 per cent (Tanzania). Morocco, with more than half of Africa's installed production capacity, used only 20 per cent of that capacity.

Numerous projects have been delayed or cancelled because of excessive costs, particularly when the building of the plant also required the establishment of infrastructural facilities. This happened, for example, in the case of the phosphate recovery projects at Abu Tartur (Egypt), Loubloïra and Bofal (Mauritania) and Matam (Senegal).

Potential of domestic markets

One of the main reasons for the under-utilization of production capacity is the insufficient absorptive capacity of the national markets. During the period 1984-1985, the consumptic of phosphate fertilizer in Africa was less than 0.6 million tonnes as against a production capacity of about 2.5 million tonnes. Fertilizer consumption in Africa per cultivated hectare is extremely low; in 1985, it stood at about 11 kg per cultivated hectare (4 kg of this amount being in the form of phosphate fertilizer) as opposed to 189 kg per cultivated hectare in Asia and 240 kg in Europe.

This inadequacy of local demand provides little incentive to increase domestic supplies. In particular, it also makes it difficult to achieve economies of scale at the production units, although such economies are essential if producers are to be able to compete with imported fertilizers. In certain cases, this competition is all the more keen because imported fertilizers receive government subsidies.

3. Measures to increase fertilizer use

3.1 Agricultural adjustment policies

Remunerative agricultural prices

Price- and subsidy-based agricultural adjustment policies are extremely complex. They vary more in their methods than in their objectives, changing to suit different situations at different times. The main purpose of such policies is to guarantee sufficient income for the producer by taking into account production costs, consumer income and international prices (often influenced by currency fluctuations).

Adjustment policies such as subsidies for production inputs are often criticized. On the one hand, they occasionally give rise to patterns of production contrary to economic rationale and produce protectionist effects, but on the other hand, they are costly and difficult to modify or eliminate. However, they should not be rejected a priori: they often support local fertilizer production and are effective when there is under-utilized production potential and they are also complementary to overall agricultural policies.

A price guaranteeing both the farmer and the fertilizer producer a sufficient return makes it possible to increase consumption, improve the distribution system and, in the final analysis, achieve greater productivity. The best solution is obviously to be able to set a price that is both close to the international market price and that ensures the farmer an acceptable return. If this cannot be done, other instruments of economic policy may be employed. Protectionist duties may be introduced to discourage the consumption of imported products. Devaluations have also been used to

increase the prices of imported products, making local production more competitive. In this case, however, subsidies must be introduced for the imported inputs, which otherwise become too expensive. And, as far as fertilizers and other agricultural inputs are concerned, the risk exists that local fertilizer producers may be put at a disadvantage.

Price and subsidy policies are interconnected. Moreover, since the farmers, located as they are at the centre of the circuit, are simultaneously producers and consumers, it is clear that adjustments have to be primarily based on demand for agricultural products and the demand for fertilizers. A production potential exists in Africa. The problem is to stimulate the demand.

Risk-sharing schemes and credit facilities for farmers

The fact that agricultural production in Africa involves great fluctuations in income and a very high level of risk means that it is necessary to share the risks but difficult to find partners willing to do so. By bringing farmers together in farming communities, it is possible to cut down on certain investment costs (inputs and machinery) and to mitigate the effect of any losses that may arise.

Another step might be to develop a kind of public insurance to cover harvests. Instead of systematically allocating input subsidies, the government could compensate a part of the input costs in the event of a bad harvest.

Credit facilities could also be extended in order to enable farmers to cope with the sizeable investments by the use of fertilizers. This implies the need to reorganize the banking system, improve the management and decentralize credit institutions by setting up more offices within rural communities.

There must also be a diversification in the available forms of credit. For example, the banks could offer credit contracts for the purchase of fertilizer, providing for repayment out of income derived from the sale of the next harvest. Following the same principle, it should be possible to develop credit suppliers, with the supplier delivering fertilizer before the harvest, to be paid for once the harvest has been sold.

Role of co-operatives, farmers' associations and producer organizations

Farmer associations, just like fertilizer producer associations, make it possible to introduce production rationalization measures both upstream and downstream: combined fertilizer orders reduce costs through more favourable prices and reduced transport expenses. Jointly owned machinery, tractors and storage as well as the rationalization of product marketing and distribution, help to lower prices and reduce fixed costs. Associations are also information exchange centres. Governments should therefore encourage the formation of these groups through financial assistance and tax incentives.

3.2 Improving the input supplies to agriculture

Small-scale fertilizer production and blending units

Small-scale fertilizer manufacturing plants offer a number of advantages. They develop local industry, they allow foreign exchange savings, they are better suited to an underdeveloped economic fabric, they adapt better to local demand and, most importantly, they entail less capital expenditure.

Africa has a great potential, especially for phosphates: small-scale production units could be installed, after careful study (raw material availability, local demand), in major producer countries, such as Morocco, Algeria and Tunisia, or in countries with modest levels of production or none at all, such as Mauritania, Niger, Senegal, Mali and Togo.

Over the long term, the establishment of a series of small production units would be the best way of creating a fertilizer industry. These small units can be gradually developed, particularly in the form of joint ventures.

Capacity utilization and rehabilitation of fertilizer plants

The effective utilization of existing capacity depends on simultaneous activities designed to improve a number of factors - infrastructure, manpower and production techniques. The first two factors, infrastructure and manpower, transcend the context of the plant and are discussed elsewhere. The point to be emphasized here is the importance of improving production techniques, for, as already noted, technical difficulties are responsible for the underutilization of capacity or the shutting down of many units.

For each fertilizer plant, a detailed study must be undertaken of the opportunities for improving the production process.

Plant and crop protection

The increased use of pesticides and herbicides is absolutely necessary to avoid the crop losses that make the use of fertilizers discouraging and pointless. These products are, however, expensive, unfamiliar and difficult to obtain. In view of the importance of the topic, it is covered separately at the Regional Consultation.

High-yield seeds

Several examples will suffice to show the importance of seed selection. In Kenya, 40 per cent of the maize plantations deliver 70 per cent of the total volume produced, thanks to the use by these plantations of an improved maize variety, the Kitale. Maize output has also been increased in Zimbawe through the introduction of the SR52 variety. In Zambia, better results have been achieved in wheat production through the use of a variety tolerating the presence of aluminium in the soil, while in Sudan, sorghum production has been boosted through the use of the Hareen Durra variety. Improved varieties of rhizomes and tubers are also producing good results (e.g. cassava).

Additional research and testing is necessary in view of the particular difficulties associated with African agriculture.

Agricultural implements and machinery

Fertilizer use cannot be increased to the required degree without the introduction of modern techniques, especially those that facilitate the spreading of fertilizers. It has been pointed out that one way of fostering the more extensive use of implements and machinery is through the formation of farmer associations. However, there must also be an increase in the local manufacture of agricultural equipment and in international assistance in this area. It is also necessary to train farmers in the proper use of the machinery and to furnish them with the means to operate the equipment effectively and to maintain it in a good state of repair (spare parts).

New types of fertilizers and application technologies

The use of traditional fertilizers, such as the organic manure obtained through the systematic recycling of crop residue, must be encouraged. But there must also be more research into developing new and innovative types of fertilizers. Certain of these are already in use in Africa, such as nitrogen-rich Azoll or, to a lesser degree, Rhizobia.

Progress in this area has been inhibited by shortcomings in research. The reasons for these deficiencies are to be found not only in sociological and economic factors, but also in the poor institutional organisation of fertilizer research. Although many different organisations are involved, their activities are not co-ordinated.

National and regional co-operation programmes should be set up with a view to co-ordinating the work of the different research centres. The aims should be to develop new fertilizers and new application technologies suitable for use in Africa.

Irrigation and water management

The first requirement for improving the irrigation systems is to collect comprehensive data on the current status of irrigation in Africa. It is judged that lasting improvement will critically depend on the following:

(a) Institutional reforms;

(b) The availability of new credit facilities;

(c) The purchase of additional equipment from abroad;

(d) Training for administrators, technicians, designers and maintenance personnel.

Depending on the situation, this may involve the rehabilitation of traditional or modern installations already in service or the building of new ones. Past experience, however, has shown that it is best to accord priority to projects that:

(a) Are inexpensive and not demanding in the way of investment and infrastructure;

(b) Require modest technical and managerial skills;

(c) Involve extensive participation by farmers;

(d) Fall within a collective framework along the lines, for example, of the approach adopted in Kenya (Provincial Irrigation Units).

3.3 Organizational considerations

It is important for African governments to formulate long-term contracts for fertilizer supply with producers. Today, bilateral agreements for trade in raw material and fertilizers (West African countries) enable the countries to go beyond the north/south traditional trade.

Africa is also confronted with the necessity of developing its own domestic markets to boost local production: Côte d'Ivoire, for example, could supply fertilizer simultaneously for its domestic markets and for the markets of Burkina Faso, Mali and Niger. Regional markets could be developed within the framework of African regional organizations (Common Africa and Mauritanian Organisation, Economic Community of West African States, Customs and Economic Union of Central Africa).

4. External assistance through international co-operation

This topic is covered under the Issue Paper II presented to the Regional Consultation.

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Issue Paper II

OPPORTUNITIES FOR INTERNATIONAL CO-OPERATION FOR THE DEVELOPMENT OF THE FERTILIZER INDUSTRY IN AFRICA*

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1. Introduction and summary

It is generally agreed that an increased production and utilization of fertilizers in Africa will depend critically on the supply of external inputs. The main vehicle for delivering the required goods and services to increase crop yields will inevitably be one of the many forms of international co-operation.

Agricultural development is a complex process in which diverse physical, political and socio-cultural elements merge in a delicate and often volatile mixture. This interaction also involves, apart from the main parameters dealt with in Issue Paper I, such factors as policies on pricing, land tenure, trade and monetary regulations and incentives and, not least, rural literacy programmes. In developing nations such as India or China, where the so-called "green revolution" has taken root, the impressive performance of the agricultural sector can be traced back to an often decisive external contribution such as new seed varieties or supply of fertilizers through bi- or multilateral arrangements.

The production inputs required by most African countries range widely from agrochemicals, seeds, agricultural implements and machinery, including spare parts, to the adoption of better farm management practices. Without adequate supplies of these inputs, the structural adjustments and agricultural reform programmes, widely advocated and often attempted, will remain ineffectual. Although the bulk of modern production inputs will originate outside the continent in the coming years, the large potential to revitalize and expand indigenous input industries in conjunction with the promotion of African intra-regional trade should not be overlooked.

It is noteworthy that, at present, seven countries in sub-Saharan Africa produce a total of some 250,000 tonnes of fertilizer nutrients, contrasted with a projected demand for the region of at least 2 million tonnes by the end of the decade.

More significantly, only two of those producers have any excess production for exports. To overcome this debilitating shortage in a key agricultural commodity, there are numerous ways in which the international community can increase the availability and promote the usage of fertilizers. It should be kept in mind that these co-operative arrangements not only benefit the recipients but also serve the enlightened self-interests of the suppliers.

In this context it should be recalled that some 98 per cent of the world's farmers actually live in the developing countries, thus offering a huge and growing market for suppliers of all kinds of agro-inputs. In Africa, some 80 per cent of the population are engaged in the agricultural sector, underlining the predominance of agrarian societies on the continent and making agriculture the crucial axis for economic development.

The continuing and rising gap between the input needs of African agriculture and their local availability opens a wide spectrum of possibilities for international co-operation. While recent famine relief operations have amply demonstrated the spirit of goodwill and concern for the African predicament, they have simultaneously relegated the root causes of the food crisis to the background. Of much more importance than food donations, which can also cause harmful effects, are measures for the long-term recovery

of agriculture on the continent. External assistance has to be sought for a coherent and systematic strategy for providing fertilizers, chemicals, seeds, implements, vehicles, water-drilling equipment and irrigation maintenance systems.

If the immense potential for increasing agricultural production in Africa is to be realized, then often haphazard farming practices must be replaced, a process that would also necessitate massive inflows of the above industrial inputs. In view of the scarcity of arable and irrigated land, future increases in agricultural output can no longer be achieved by extending areas under cultivation but must be gotten by intensification techniques that increase crop yields from existing acreage. A major study on African agriculture by the Food and Agriculture Organization of the United Nations in 1986 declared emphatically that future production increases could only result from the higher productivity of land and labour.

2. Co-operation in the establishment of fertilizer manufacturing facilities, including blending units

2.1 Feasibility and pre-investment studies for manufacturing plants and blending units

The intensive employment of fertilizers as a means to increase agricultural productivity, although a general practice elsewhere, remains in its infancy in many parts of Africa. The consumption of fertilizer nutrients in Africa today stagnates at a far lower level than in other developing regions of the world and is consequently at a fraction of application rates prevalent in industrialized countries.

At the same time, the rate of increase in the consumption of fertilizers in the developing countries has been appreciably higher than that in the developed countries in the past two and a half decades. Experience has also demonstrated that local production has invariably accelerated the demand for and consumption of fertilizer products.

However, a prerequisite for the establishment of manufacturing units on the continent would be detailed location-specific feasibility or pre-investment studies. A study on mini-fertilizer plants conducted by UNIDO has identified 24 countries in Africa fulfilling the requirements for the construction of such plants. This finding was based on initial surveys of natural resources, agricultural potential, fertilizer demand projection and import-export balances. The mini-fertilizer study further revealed that in the majority of cases, the cost of production of nitrogen and phosphate fertilizers was economically competitive with the cost in world-scale plants. When the cost was calculated at the farm gate, i.e. as delivered to the farmer, the small-sized plants proved even more advantageous.

International co-operation could be critically important to the undertaking of comprehensive pre-feasibility studies for selected locations. These studies would to assess all the critical elements that relate to the economics and technology of small-sized pilot plants, including current and projected demand, technological alternatives, raw material availabilities, environmental considerations, equipment and machinery needs, technology and know-how transfer and manpower requirements. Such pre-feasibility studies would incorporate full financial analysis on investment and production costs, commercial viability, revenues, project financing plan, sensitivity analysis

etc. The value of the market opportunity for contractors, manufacturers, process technologists and suppliers for 1990s in the fertilizer industry of developing countries is estimated at $25-30 billion, making North-South co-operation a lucrative business proposition for both parties.

2.2 Strengthening Africa's technological capabilities related to the fertilizer industry

Demand projections for fertilizers in African countries show the need for a number of manufacturing/blending plants by the year 2000. Since some African countries already possess considerable resources in most areas of the industry, such projects could be successfully undertaken within a framework of intra-African co-operation for mutual benefit. Such co-operation could prove advantageous with respect to plant design and engineering, construction, operation and maintenance, manpower training, marketing and R and D.

In view of the wide diversity of fertilizer industry experience among African countries in this sector - notably in relation to raw material endowment, national production, export potential, process technologies, technological capabilities, training facilities etc. - it is judged that a systematic assessment of these parameters in general and the technological capabilities existing in Africa in the phosphatic fertilizer industry would be a pre-requisite for international co-operation.

In the phosphatic fertilizer industry, the available resources and the pressing needs of the African countries complement each other to a high degree. Collectively, the countries of the continent enjoy both significant production capacity and market potential for fertilizer products. North Africa, as a major exporter to international markets, has acquired a vast body of experience in all phases of the industry, ranging from geological prospecting to process design capabilities. However, the many constraints to industrial co-operation have effectively precluded the tapping of the large reservoir of mutually beneficial schemes.

The slow rate of progress can be attributed to a variety of factors, including differences in administrative, legal and political systems; colonial inheritance; entrenched commercial interests; indebtedness and balance of payment difficulties; lack of information and confidence-building measures; and insufficient accommodation in industrial policies.

The proposed establishment of a Fertilizer Development and Information Network for Africa (FADINAP) will certainly prove useful, especially if in addition to providing trade and price information, it contained an inventory of technological capabilities related to the fertilizer industry on that continent.

2.3 Problems in project planning, construction and operation of fertilizer plants

Another key area of international co-operation, particularly among developing countries, would center around the judicious use of the experience of established fertilizer producers. This exchange of experience in the construction and operation of fertilizer plants could provide valuable and practical knowledge to the project teams of new fertilizer plants. Problem areas can be identified in virtually every phase of such a undertaking, but a few areas stand out:

(a) Feasibility studies;

(b) Pre-contracting, with special emphasis on the preparation of tender specification and bid comparison;

(c) Contracting. This being the key factor for the successful completion of the plant, its provisions must be carefully negotiated, particularly in respect to licenses, basic and detailed engineering, civil work, plant erection, mechanical testing, pre- and commissioning, performance guarantee demonstration and, finally, mechanical warranties.

As far as operation and maintenance problems in fertilizer plants in developing countries are concerned, international co-operation would be highly pertinent in respect to industrial maintenance, training of manpower and spare parts.

The experience of seasoned fertilizer producers in other developing regions has demonstrated that the main problem areas in respect to production are the following: quality control, capacity utilization and raw materials and utilities.

Other areas such as safety, pollution control, production costs, marketing and distribution and pricing also pose serious problems to new entrants. Although many of these problems are common to all developing regions, a sharper focus on the specific difficulties of the African fertilizer industry could be gained through a systematic exchange of experience and information between the plant and project managers of the continent. This would provide an opportunity to arrive at efficient solutions to a variety of recurrent problems faced by the industry.

2.4 Information on machinery, equipment and spare parts, including engineering and technical services

Updated, comprehensive and authoritative information in the above areas is a basic need for countries that are planning, developing or expanding their fertilizer industries. The necessity for directory of this sort has been repeatedly expressed at international conferences dealing with this sector. Officials in developing countries are often insufficiently aware of the range of process technologies and machinery available world-wide that would give them a cost-effective choice of alternatives suited to their particular requirements.

International co-operation and assistance from industry is needed to compile the pertinent information on manufacturers of equipment, spare parts and catalysts; process technologies; terms and conditions for acquisition and transfer; track records on similar installations; engineering contracting firms; training; R and D facilities etc.

The intelligent use of this information will undoubtedly facilitate the choice of technology as a function of:

(a) Optimal utilization of indigenous raw materials;

(b) Operation, maintenance and technical back-up characteristics;

(c) Responsiveness to local market potential;

(d) Industrial and infrastructural realities;

(e) Capital cost structure of technology;

(f) Limitations of a genuine transfer of know-how imbedded in technology;

(g) Requirements of and impact on manpower training and development.

2.5 Survey of joint-venture potential for the development of a fertilizer industry in Africa encompassing industrial and commercial activities

Industrial co-operation between countries plays an important role in developing business relationships. One of the major vehicles for international collaboration is joint ventures. Although the failure rate is high for joint ventures in processing industries involving a developing country partner, this vehicle, if used judiciously and flexibly, does offer a great potential for realizing the industrial aspirations of the developing countries. A pre-requisite of such arrangements is an intimate understanding between partners on all aspects before an agreement is entered into. This process is both time-consuming and intricate, and its crucial importance is often underestimated by the parties involved.

The motivations behind the formation of joint ventures in developing countries are diverse but can be grouped basically in four categories

(a) Market-oriented;

(b) Raw-material-oriented;

(c) Technology-oriented;

(d) Miscellaneous.

The last heading covers cases where advantage is taken of special situations such as the provision of credit lines by international or regional financial institutions.

Joint-venture arrangements in the fertilizer industry involving developing countries are a relatively recent phenomenon. For the most part they involve commercial commitments by foreign firms to exploit the raw material resources of the developing country, with the fertilizer products being sold in local and/or international markets.

Many potential projects are hampered by the difficulty of financing the substantial investment needed for the mining and infrastructural facilities. However, linking production capacity to an assured market outlet would seem to present the basic condition for the implementation of joint-venture projects involving developing countries.

As part of the preparations for the regional Consultation, UNIDO has undertaken a survey to ascertain the potential of joint-venture arrangements for the development of the phosphatic fertilizer industry.

2.6 International co-operation in the design, engineering and manufacture of machinery and equipment suited to the needs of developing countries

Developing countries have, on the whole, depended on foreign technology for the manufacture of fertilizer products. However, this technology was conceived under specific conditions, and certainly not as an escape route from underdevelopment. It does not, therefore, necessarily correspond to the special requirements and priorities of developing countries, a fact which renders its technical absorption and assimilation an onerous task. Furthermore, the problem can be compounded by a lack of technical back-up from the contractors or licensors for the efficient, safe and on-spot operation of the processing plants under the conditions prevalent in developing countries. This also holds true from the perspective of the construction, assembly and erection of the plants, contributing to significantly higher capital expenditures in comparison with similar projects implemented in industrialized countries.

Certainly, one major factor is the inadequacy of support from and the interaction with home-grown research and development capacity necessary for the absorption and adaptation of foreign technology.

There is, accordingly, a wide scope for international effort and specially South-South co-operation to transfer to African countries those proven technologies which take due account of the socio-economic and industrial realities of the continent.

To carry out meaningful research and development at the national level obviously necessitates mobilizing considerable resources, both in manpower allocation and capital expenditures. This in turn will be effective only in conjunction with a well-entrenched scientific infrastructure and technical organization. The required number of highly qualified scientists, engineers and managerial talent, backed up by adequate facilities and equipment, is certainly beyond the means of all but very few developing countries.

International co-operation is therefore a viable means of developing and transferring the appropriate technology for the fertilizer industry in Africa.

3. Efficiency improvement and rehabilitation of fertilizer plants

3.1 Human resource development of plant operators, supervisors and middle management

Poor maintenance and low operational efficiency of existing fertilizer plants contribute significantly to the high cost of production in many African countries. In some instances, manufacturing units operate at well below half their nameplate capacity and entire plants are sometimes idle.

The revitalization of established production units is often a cost-effective way of lessening supply constraints for fertilizers. By giving technical and financial support, the international community and particularly the fertilizer fraternity can help African organizations and enterprises to set up systematic in-service, on-the-job and in-plant training schemes.

Development and commercial banks, as well as multilateral and bilateral institutions, can also ensure that comprehensive training and, particularly maintenance, are well integrated in the financing for rehabilitation projects.

As a recent UNIDO Consultation on the subject concluded, international co-operation in manpower training may take place through collaboration at the international, regional and subregional levels. This will include the exchange of experience and information, provision of training, common use of training facilities, establishment of productivity and maintenance improvement centers, exchange of plant managers and technical personnel and the identification and implementation of technical co-operation projects in developing countries.

In the final analysis, the prospects for all industry in Africa will hinge on the development of human resources at various levels, ranging from policy-makers and entrepreneurs through technologists and technicians to skilled labourers.

3.2 National/regional capabilities for technology assessment and procurement

Appropriate choice of technology is of crucial importance for avoiding both an unnecessary wastage of scarce resources and a distortion of the pattern of development in a vital industrial sector.

Many African countries do not allocate manpower and institutional resources to evaluate, acquire, adapt, diffuse and absorb foreign processing technologies. In the absence of such capabilities, government agencies and private enterprises involved in the fertilizer sector have been left to their own devices or been given biased advice on the choice of technology. As a result, they have on occasion purchased defective equipment and machinery or plants inappropriate to the local environment and raw materials.

It is imperative to enhance national abilities of technology assessment and procurement. As a first step, international co-operation could aim at providing comprehensive information on sources and prices of major factor components and process technologies needed in the fertilizer industry. Here again, the scope of South-South co-operation is considerable in light of process engineering and technological advances made by some African countries in all the phases of the phosphatic fertilizer industry.

3.3 Advisory and trouble-shooting groups for the provision of technical and operation support to fertilizer plants

Established fertilizer producers have a vast and valuable body of experience which could be put to work for the benefit of the African fertilizer industry. In particular, successful fertilizer projects in other developing countries have generated insights into the economic and technical suitability to the conditions prevailing in these countries. In this context, the relationship between technological complexity and the mastery of the plant in operation and maintenance is of obvious relevance.

To facilitate the flow of technical experience between project/plant managers, informal advisory groups or even technology clubs could be formed. The main function of such groups would be to provide timely and cost-effective solutions to the numerous technical problems faced by African fertilizer plants in their daily operations. The tasks of the advisory group could be

extended to cover other phases such as feasibility studies, pre-contracting, tender specification, bid comparison, contract negotiation, engineering, procurement, construction and, finally, commissioning and plant start-up.

These areas are particularly relevant in the African context since at present only seven sub-Saharan countries possess fertilizer industries, and these produce approximately a quarter of the region's current consumption of fertilizer products.

4. International co-operation aimed at increasing the supply of other agro inputs

4.1 Pesticides and related agrochemicals

Pest control is widely recognized as an essential element in protecting livestock, plants, crops and stored agricultural products. If the target set for the expansion of food production in Africa is to be met, it can only be accomplished by a corresponding use of all modern production inputs, including agrochemicals and the adoption of sound farm practices. Chemical plant and harvest protection agents figure prominently among the factors influencing the prospects of agriculture on the continent.

It is estimated that the use of pesticides increases agricultural productivity by some 45 to 50 per cent. Production facilities for pesticides in the developing countries are relatively few in number and mainly involve the formulation of single products or products containing high levels of commodity-type products.

In view of the capital-intensity and research-intensity of the industry, the share of developing countries' indigenous manufacture of active ingredients is expected to remain modest in the near future and will be limited to very few countries. A few developing countries have acquired considerable expertise on the various aspects of the industry, such as environmental and health protection requirements, registration and control, efficient utilization etc.

To gain a better understanding of the sector particularly with respect to (a) pest and pesticides management practices; (b) handling, storage and application of pesticides; (c) selection of pesticides materials and formulation; and (d) procurement of pesticides, the regional consultation will tackle this sector separately under an issue paper submitted by the UNIDO Secretariat.

4.2 Seeds more responsive to fertilizer application

The real breakthrough in the use of fertilizers in India's "green revolution" was caused by the introduction of high-yielding varieties of seeds in the mid-1960s. These varieties with high fertilizer response ratios convinced the farmer of the merits of adequate application of fertilizers. Wheat, rice, sorghum and pearl millet production all experienced significantly higher growth rates as a consequence of the new high-quality seeds. In fact, it has been argued that unless high-yielding seed varieties are put at the disposal of the farmer, the application of fertilizers will not take off.

Basic production and quality control of new seeds offer cost-effective and immediate mechanisms for boosting agricultural productivity.

However, apart from developing and supplying the new seed varieties at the farm gate, effective measures must be taken to demonstrate the advantages in their use to the farmer. Experience has shown that this acceptance presents a major challenge to the extension services.

International co-operation was instrumental in Asia for the provision of improved quality seeds which heralded the "green revolution". In Africa, the international community has responded less vigorously so far in this field. External aid in the form of providing appropriate seeds to African farmers has also been less than impressive in recent years.

4.3 Improvement of the quality of agricultural extension services

The perception of a farmer's cost/benefit ratio as a result of introducing modern agricultural inputs to his farming practices remains the key element in productivity improvement. The most immediate and lasting influence on that perception, including the psychological responses of the farmer, can be exercised by appropriate extension services. Effective communication on a regular basis between the farming community and adequately trained front-line extension staff has, in Asian experience, provided a vital tool in boosting yields.

However, the promotion of any isolated single input will be futile unless accompanied by other supporting inputs and measures. In fact, if simultaneous and steady progress is not made in all necessary inputs, fertilizer consumption will suffer disproportionately as the weakest element in the chain of agricultural production. The two types of extension services prevalent in Africa, which can be classified as (a) specific transfer of knowledge through an extension worker or (b) farmer participation in decentralized technological transfer, have already contributed considerably to the introduction of new techniques in certain areas, especially in export crops.

As the Food and Agriculture Organization of the United Nations points out, the components of success have invariably been the existence of a valid technology package, efficient distribution of credit and inputs, a guaranteed market and close extension worker supervision. However, precisely because of these requirements and their relative costliness, the system has severe limitations for grass-root, food-crop communities.

Other types of extension services catering to specific and well-defined agricultural situations have been suggested and tried in African countries. Amongst these, the small-scale, so-called "systems approach" extension, which regards the technical problems of agriculture from the viewpoint of the farm as a whole and involves close farmer participation, has recorded some notable successes.

However, the technical problems of extension work in Africa remain formidable. No single recipe or formula can be found for general application, yet the search for the most appropriate arrangements for each individual situation will necessitate co-operation among those partners having the relevant experience and technical know-how.

The areas of this co-operation range from a reinforcement of the R and D base to the continuous training and adaptation of extension workers. Here again, a number of experimental schemes involving many national and international agencies have been implemented in recent years. The need for and the scope of international co-operation in the field, however, remain considerable.

4.4 Port facilities, transportation and delivery systems

Agriculture can only develop through a synergetic interaction with various supporting sectors of the economy. As argued previously, the level of fertilizer use will depend ultimately on the symbiosis of those factors responsible for supplying the external inputs to agricultural production.

In fact, transportation and distribution networks for handling fertilizer products in the required quantities are unsatisfactory in most African countries. This inadequacy of the delivery system inevitably leads to increases of costs and delays in procurement.

Although recent years have witnessed considerable progress in some African countries in improving fertilizer handling and distribution facilities, there is a continuous and growing need for maintaining and consolidating this infrastructure. Other countries in Africa are faced with a deteriorating situation with respect to port facilities, transportation, storage and distribution. These constraints are well illustrated by recent difficulties experienced in handling the food aid deliveries of grain etc. Unless the supply disruptions caused by inadequate infrastructure are eased, fertilizer use by farmers cannot be appreciably increased and sustained.

As a recent FAO study on African agriculture concludes, international assistance is required to improve the handling and discharge capacities of ports, to purchase transport vehicles, to construct storage facilities near ports and other strategic areas, to procure spare parts and to provide maintenance facilities, as well as to train truck drivers, mechanics and logistic and planning personnel.

5. Co-operation in regional trade in fertilizer intermediates and final products

The option to either produce domestically or to import fertilizers obviously depends on such factors as resource endowment, size of domestic market, pattern of demand, geographical location, technological capabilities, capital availability and foreign exchange position. In view of the fluidity of the international context, some of these factors are to a varying degree influenced by external factors. Whatever option is taken in respect to the supply source of fertilizers, regional co-operation for marketing and distribution of these products can greatly contribute to their farm gate availability and to reducing delivered costs.

For those countries with limited fertilizer demand or for small or landlocked countries, such joint schemes offer even greater advantages.

5.1 Long-term supply contracts and joint import schemes

The formation of a more efficient institutional infrastructure for fertilizer marketing and distribution at a regional level can also provide the required impetus for an increased use of fertilizers by providing technical and other services, such as:

(a) Advice and demonstration to farmers on fertilizer application;

(b) Training of manpower for the various phases of the fertilizer sector, particularly market development and distribution;

(c) Assessing the magnitude and nature of future fertilizer demand;

(d) Facilitating collective procurement of regional fertilizer imports;

(e) Promoting the establishment of manufacturing and blending units on a regional basis;

(f) Forming an appropriate framework for the exchange of information and experience in production, marketing and distribution of fertilizer products;

(g) Assisting national institutions in collection of statistics relative to fertilizer use and supply, research and development activities;

(h) Identifying recurrent problems in production units and their effective solutions.

African countries, like other developing regions, are somewhat handicapped in their international procurement by a lack of information and negotiating skills. This invariably results in a weakening of their bargaining position vis-à-vis experienced international traders pursuing short-term commercial interests.

On the other hand, the import dependency of most sub-Saharan African countries for fertilizers is expected to remain considerable because it is unlikely that domestic production will increase substantially in the near future. The cost-effective and timely procurement of fertilizers thus assumes a great importance for African agriculture.

Regional co-ordination of fertilizer purchases by a group of countries greatly enhances their bargaining position, leading not only to savings but also to other tangible advantages, such as joint tendering and bid evaluation, formulation of specification, desired timing of delivery, optimal mode of transportion and distribution arrangements.

Furthermore, because of the larger tonnage involved in collective requirements, negotiations can be held directly with manufacturers, thus eliminating trade margins. The producers also have vested interests in concluding long-term supply agreements which protects them against unpredictable and volatile market fluctuations. By purchasing an agreed quantity and quality of fertilizers over an extended period of time on predetermined terms, considerable advantages can be achieved over individual spot purchases on international markets. Needless to say, a secure and long-term supply of fertilizer so assured can play an important role in national agricultural policies. Such co-operative procurement arrangements would require close co-operation between the national fertilizer procurement agencies of the interested group of countries. A centralized agency having access to up-dated market intelligence, procurement specialists, detailed information of fertilizer requirements, long-term relationship with producers etc. could function efficiently in supplying the needs of the participating countries.

5.2 Reassessment of regional fertilizer marketing and pricing policies

African countries have experimented with a variety of marketing and pricing policies for fertilizer products. The results of the diverse policies on incentives have, on the whole, not been very successful. In most countries, the government plays a major role in the marketing system through para-state marketing and distribution bodies. The performance of these agencies in many cases needs improvement to rid them of cumbersome bureaucratic administrations.

The Food and Agriculture Organization of the United Nations has undertaken detailed reviews of input marketing systems and policies in a number of African countries, identifying the main constraints to improved marketing and has suggested alternative policy options. However, further international co-operation is required to provide technical advice and training assistance to those countries overhauling their fertilizer and other input marketing practices.

6. Direct external assistance for the development of the industry in Africa

6.1 Contribution by financial institutions in support of fertilizer projects through innovative financing schemes

Fertilizer projects are characterized by their capital intensity and their requirements of foreign technology and equipment. Domestic financial resources in most developing countries and particularly in Africa bear no relation to the financing needs of these projects, making the foreign infusion of capital or equity participation a necessity in most cases. However, in order to attract foreign capital, be it from institutional lenders or private investors, a number of increasingly difficult conditions must be met with respect to:

(a) Raw material supply;

(b) Construction and operation of the plant;

(c) Pricing of feedstock and products;

(d) Marketing arrangements;

(e) Political, monetary and related risks.

The strict criteria for assessing the above elements in devising project structures of new fertilizer plants in developing countries, has led to a diminishing availability of foreign funds needed to finance these projects. In spite of this regrettable trend, the fact remains that there are great potential rewards, both financial and social, in the local manufacture of a basic agricultural commodity increasingly in demand in Africa.

International co-operation can make a real contribution to the financing of fertilizer projects, tackling the root causes of their perceived commercial non-viability by ensuring:

(a) Provision of up-to-date design, process engineering, equipment and technological know-how;

(b) Plant errection and construction cost within budget;

(c) Production stabilization, operational efficiency and technical back-up;

(d) Realistic and long-term pricing policies of both feedstocks and products;

(e) Adequacy of working capital;

(f) Infrastructural improvements for marketing and distribution;

(g) Manpower training.

These constraints continue to affect the production performance of existing fertilizer plants in developing countries and seriously hamper the prospects for the establishment of new units. Their removal will undoubtedly help in attracting new capital to such industrial projects. Nevertheless the valuation of economic costs and benefits relative to domestic production of fertilizers in developing countries will have to reflect the development strategies and social priorities, including government policies toward food self-sufficiency.

On the other hand, rigorous economic appraisals of new fertilizer projects are a sine qua non condition, if the scarce capital resources of developing countries are to be employed optimally.

In this context, it might be useful to point out that UNIDO has prepared an in-depth study on the capital cost minimization of fertilizer plants built in developing countries. The World Bank has also prepared a comprehensive report on investment and production costs for fertilizers containing valuable information on investment and production costs, including those for energy, raw materials and realization prices required to cover costs for different scenarios.

6.2 Strengthening the negotiating abilities of African decision-makers in technology transfer contracts

Many African countries have convincingly argued that often the root causes of malfunction or underutilization of established industrial complexes were not necessarily technical or internal but largely due to built-in constraints at the initial stage of project conception, evaluation and contract negotiation. Experience has indeed shown that contractual arrangements entered into by developing countries for setting up chemical and fertilizer plants have often lacked adequate safeguards and guarantees necessary to ensure that a project would be completed on time within the stipulated budget, and that it would operate consistently at near nameplate capacity thereafter.

Traditional contracts have also revealed serious weaknesses in the legal provisions, leading in many cases to prolonged disputes and arbitration. More significantly, the nature and the content of contracts for similar plants are known to vary substantially from country to country, depending on the experience of the purchaser and his negotiating skills. While some of the developing countries with longer experience of industrialization than others have been able to negotiate better balanced contracts containing adequate provisions to safeguard their interests, others, lacking in comparable experience and skill, have fared far worse.

It is in this situation that it was considered desirable by UNIDO to pool the experiences of developing countries in setting up fertilizer projects and to systematically examine the problems they have faced in drawing up contracts. This effort, jointly undertaken by experienced lawyers of developing and industrialized countries, has led to drafting of model forms of contract for the construction of a fertilizer plant, including detailed technical annexures. The aim of these model contracts is to provide for a better negotiating balance between purchasers in developing countries and internaticnal contractors. The approach and method of work adopted to prepare these documents are characterized by the following considerations:

(a) To encompass a broad spectrum of opinions;

(b) To harmonize existing industrial practices and introduce new concepts;

(c) To provide negotiators from developing countries with both substantial guidelines and practical examples for contract drafting.

There is a large scope for the application of these documents in Africa, as well as other, similar efforts aimed at the same objectives.

6.3 Formulation of technical specifications and uniform standards for machinery and equipment

Developing countries import the vast majority of capital goods needed for their fertilizer industry in addition to the corresponding process know-how and basic engineering. In procuring equipment like high-capacity compressors, pumps, steam turbines, electric motors, pressure vessels and converters, they are confronted with a confusing array of different manufacturers' standards. Much of this machinery is not exclusive to the fertilizer sector but is common to most large-scale processing industries.

Considerable savings and operational advantages could be secured by streamlining the technical specification and norms of these units. Materials management, spare parts inventories, quality control requirements, technical services, maintenance etc. would all benefit greatly from uniform technical specifications.

Uniformity of basic industrial equipment would also contribute effectively to the diffusion and assimilation of technology in a larger economic context. Likewise it would facilitate the domestic fabrication of some of the machinery, equipment and spare parts at a later stage.

It should however be pointed out that the above cannot extend to critical and specialized components whose sources of supply will remain restricted to a few industrialized countries.

The option of unifying and streamlining specifications of imported, general-purpose machinery and equipment might also include critical construction material such as refractories and special insulation and, possibly, catalysts.

6.4 African centers for fertilizer information, research and development

The special preparatory meeting to the regional Consultation convened earlier this year recommended that, considering the importance of the fertilizer sector, the breadth of information required to manage it

efficiently, and the positive experience gained in other developing regions of the world, the creation of an African center for information on fertilizers be supported. The meeting further urged national governments to upgrade their existing statistical and information systems in the sector.

The functions of such a center could encompass:

(a) Assessment of physical, chemical and mineralogical characteristics of raw material resources;

(b) Agronomic efficiency evaluation of fertilizer use for specific soil/crop systems;

(c) Identification and adoption of process technologies, particularly for small-scale plants;

(d) Research into fertilizers and application technologies;

(e) Regional standardization in packaging;

(f) Utilization of research efforts conducted elsewhere;

(g) Information, extension and training requirements of the sector.

African countries, fully aware of the potential benefits to be derived from the establishment of an information network in the sector, and with the assistance of International Fertilizer Development Center, are currently engaged in the creation of such a facility in Zimbabwe. The positive experience gained through the operations of FADINAP at Bangkok has provided added impetus to this effort.

As far as proper research and development activities in the sector are concerned, external assistance for the creation of national/regional centers will be required in all phases of these activities. It is through international co-operation that regional priorities in important areas of R and D in the fertilizer industry relevant to developing countries can be identified. At a later stage, the experience thus gained would serve as a basis for concrete joint action to promote the development and diffusion of new fertilizer technologies.

6.5 Co-ordinated technical assistance activites in African agriculture

In Africa, as elsewhere, the elaboration and implementation of a clearly defined agricultural policy at the national level remains the foremost prerequisite for the orderly and long-term development of the sector.

One of the implications of adhering to the requirements of a coherent agricultural policy is a seamless incorporation of all external assistance into the main orientations of such a policy. Such an approach would require a systematic integration of external assistance projects and programmes into the exigencies and priorities established for the rehabilitation of African agriculture. Yet, recent experience has demonstrated not only that external supports from a multitude of sources are not coherent among themselves but also that they do not always contribute to the attainment of the long-term agricultural objectives set by national governments.

Thus it can be argued that recent food donations, in spite of alleviating emergencies of famine and drought, are in themselves no substitute for effective and long-term measures to overcome the obstacles to agricultural development in Africa. Other acts of external assistance have often reduced producer incentives and caused a growing tendency to meet demand by imports.

Yet the indebtedness of Africa, coupled with other constraints confronting the national governments, means that dependence on outside assistance to provide inputs and know-how will undoubtedly increase over the coming years. The efficiency of this technical assistance will depend on a reassessment of their genuine role in the development of African agriculture.